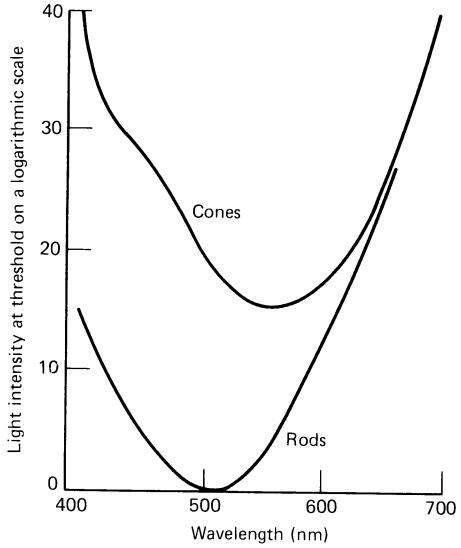
The Human in Man-Machine Systems

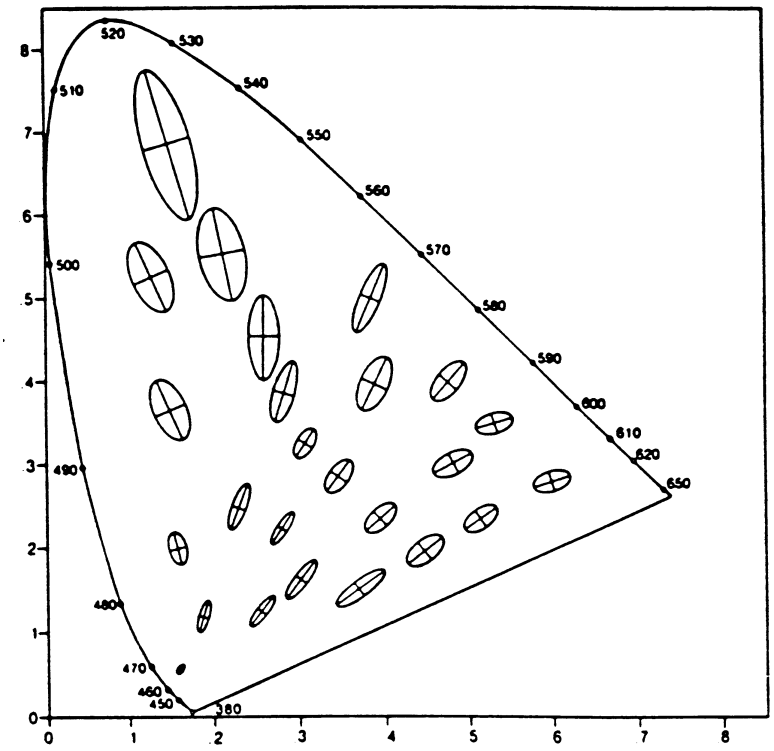
[Preece Chap 3-10; Newman Chap 3]

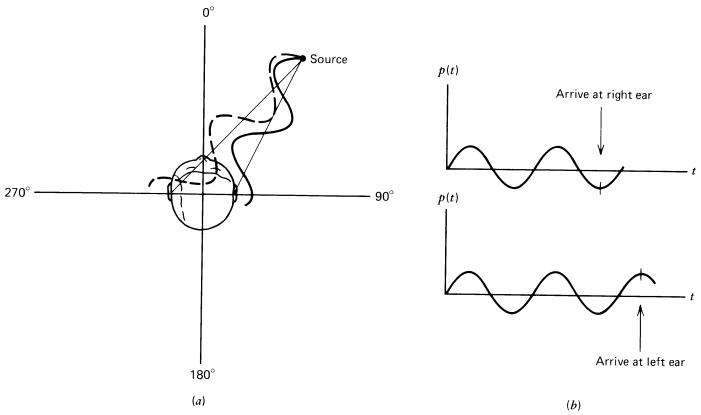
Perception

Design should consult ergonomic and physiological data.

- Visual acuity,
- Color perception,
- Depth perception, etc.






0°
Source
270°
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(a)
p(t)
Arrive at right ear
t
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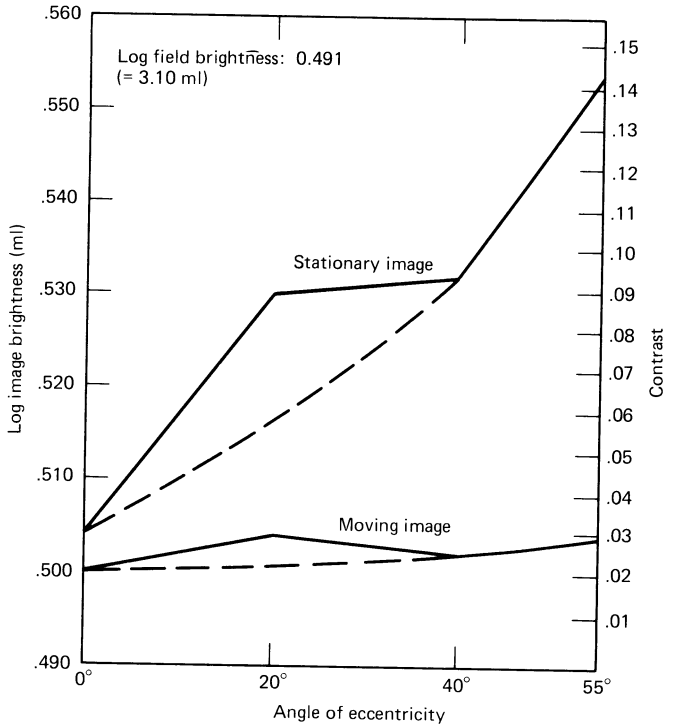
Arrive at left ear
(b)


Log field brightness: 0.491
(= 3.10 ml)
Stationary image
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.560
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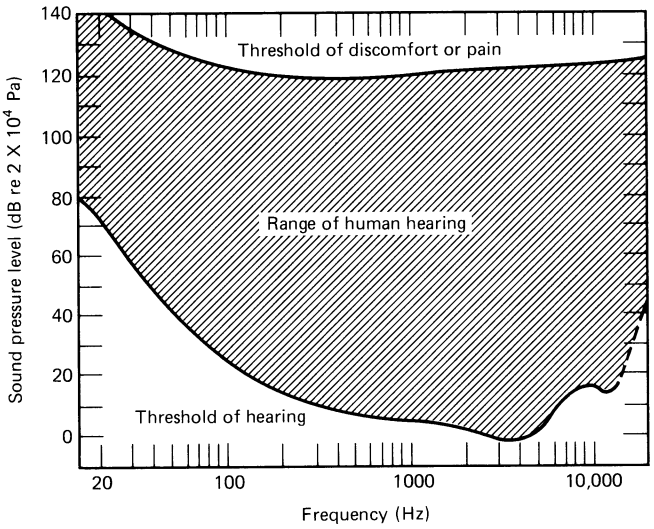


Useful in determining coding methods for visualization:
This data is strongly related to just-noticeable-difference (JND) data.

Coding Method	Maximum Number of Codes
Alphanumerics	unlimited
Shapes	10-20
Color	4-11
Line angle	8-11
Line length	3-4
Line width	2-3
Line style	5-9
Object size	3-5
Brightness	2-4
Blink	2-4
Reverse video	no data
Underlining	no data
Combinations	unlimited

Perception is more relevant to virtual environments where visual acuity is never as high as it is under normal conditions. Current head-mounted displays lower acuity often below legal blindness levels. Use of textual information is impractical. Detail that would easily be discernible in reality may not be visible at all in a VE.

Empirical Laws

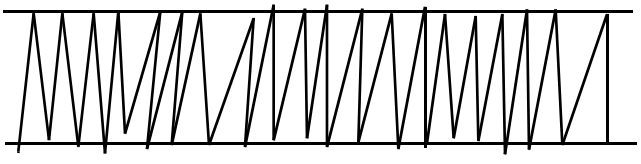
Hick's Law: The time T to choose between a number of alternative choices is a function of the number of choices n, and it is logarithmically related.

$$T = k \log_2 (n+1)$$

Short term memory: The number of items a person can maintain in short term memory is

$$7 +/- 2$$

Cycle times (t). It takes approximately 70 msec for the motor system to signal and execute a reversal. A full cycle consists of a motor movement, perceptual following, and cognitive correction -- Initiate movement, follow with the eyes, decide if correction is necessary, repeat. Total value: 100 + 70 + 70 = 240 msec.

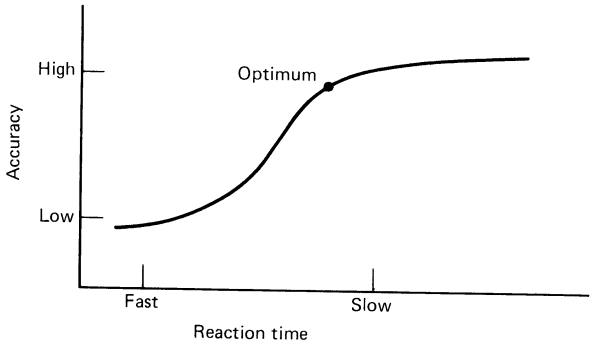


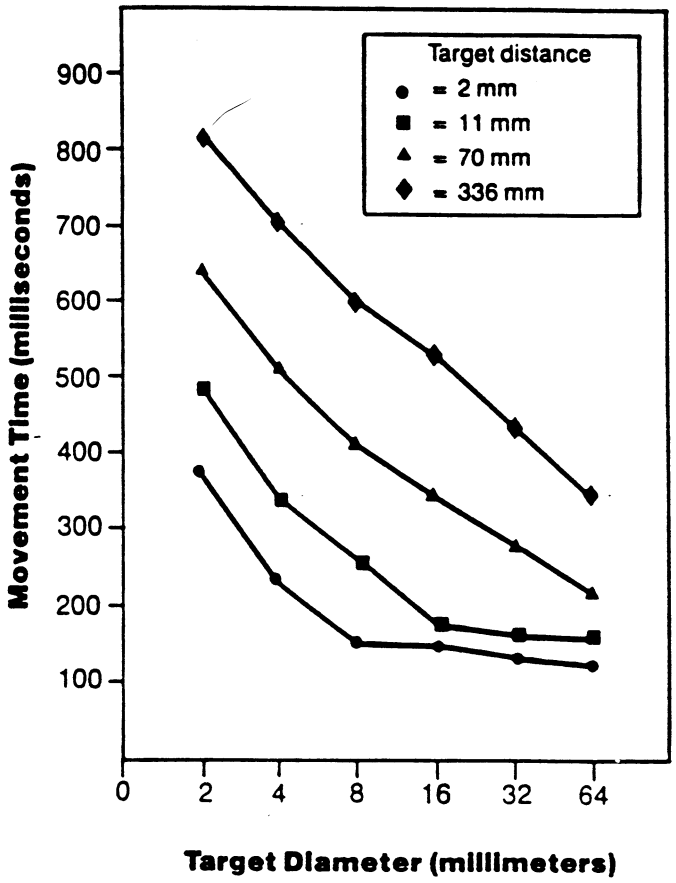
5 sec trace, we expect approximately 71 oscillations, but we get about 20

Fitt's Law: The time T_{pos} it takes to hit a target is logarithmically related to the distance A and the width W of the target

$$T_{pos} = K \log_2 (A / W + 1) \text{ where constant } K = -t/\log_2 \varepsilon$$

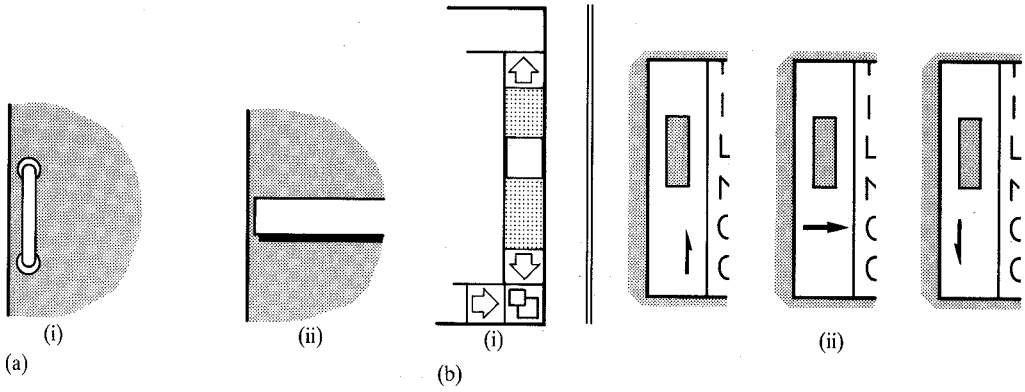
t = 1 cycle = 240 msec.





Affordances:
Visual attributes suggest a particular usage.
A doorknob suggests turning and/or pulling.

Scrollbars suggest moving up and down.



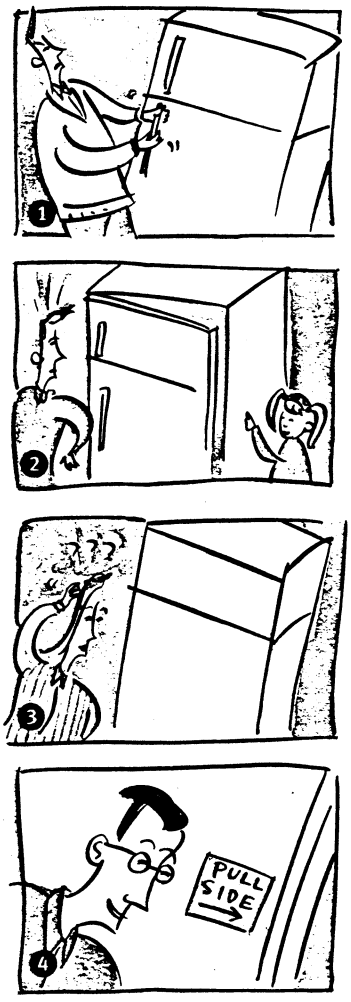
Reality Check: The Refrigerator Handle as Affordance

Several years ago, when our family needed more space, we did the logical thing and changed apartments. One of the possessions that we brought with us to the new apartment was our old refrigerator. When we arrived, we found that the refrigerator didn't work very well with the layout of our new kitchen, so we decided to reverse the direction that the door opened.

Even though we installed new hinges on the other side of the door, we had no way to move the door handle, so we left it where it was. ❶ As a result, whenever a guest went to use the refrigerator and pulled on the handle, nothing happened. Our three-year-old daughter, Arian, who wasn't tall enough to reach the handle in the first place, would run over and show the confused guest how to open the door at the seam. ❷

We eventually removed the handle altogether, in the mistaken belief that doing so would make things easier for guests. After we did so, we discovered that guests would just walk up to the door and stare at it ❸, or search for a foot pedal; Arian still had to teach them how to use it. As it turns out, all we had to do was write the words "Pull Side" on the door, with an arrow indicating the proper side. ❹

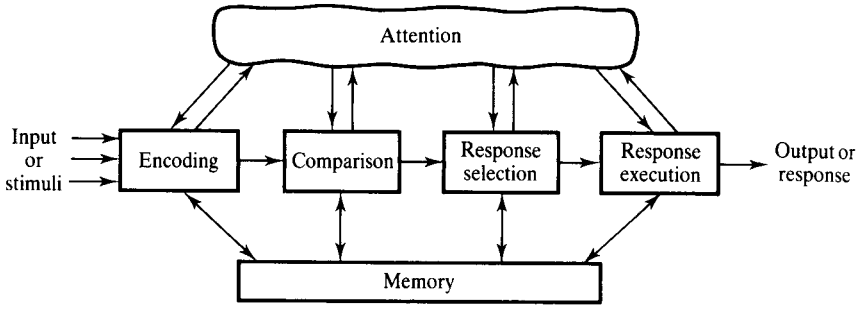
In this instance, the handle is an affordance; it communicates how the refrigerator is to be used. Even though you could still operate the fridge without it, that method of use didn't become self-evident until we had included an affordance that spoke to the needs of our "users."

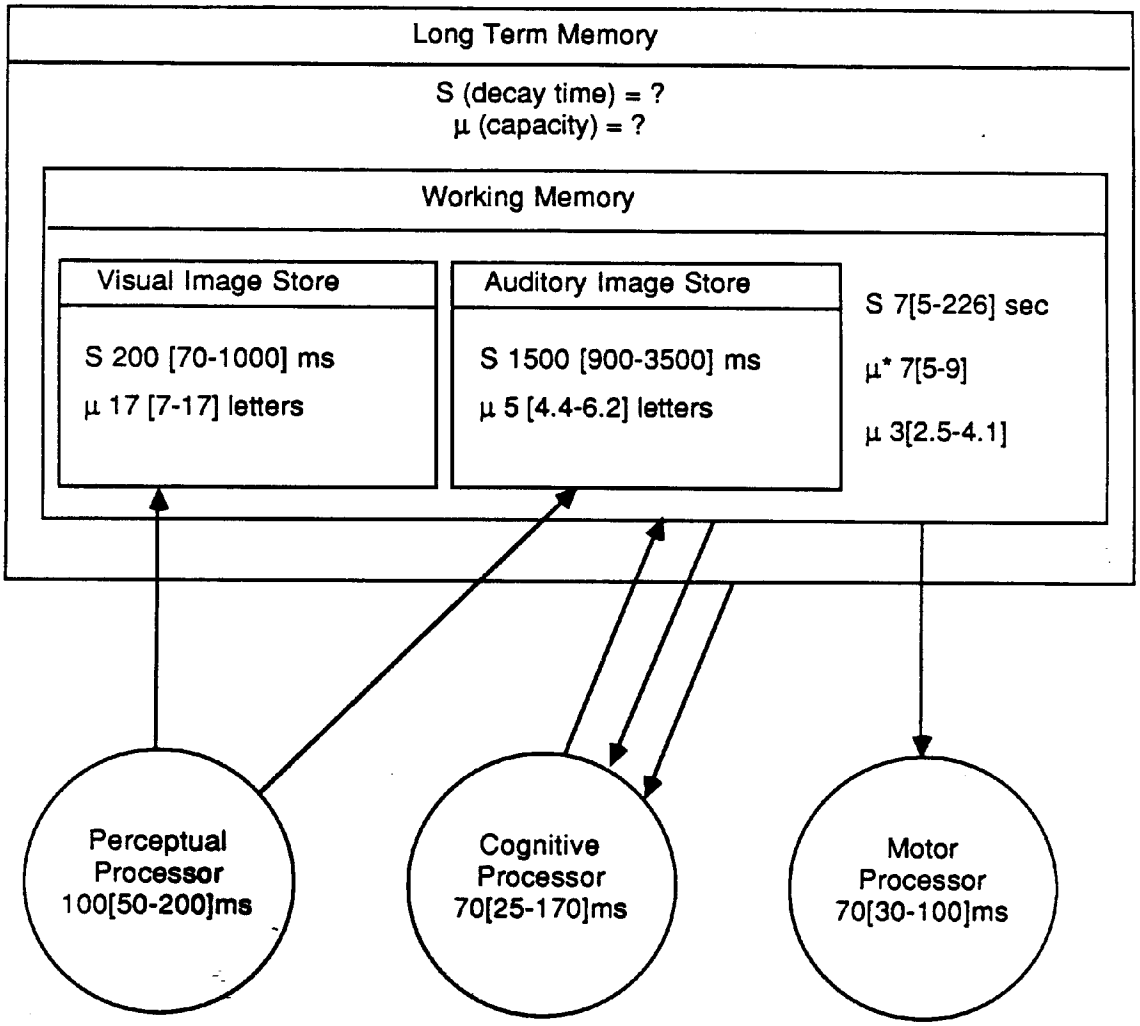


Attention and Memory

The classic model of attention and memory. The information processing model.
This is a theoretical model of how human perceive, process, and act upon environmental information.

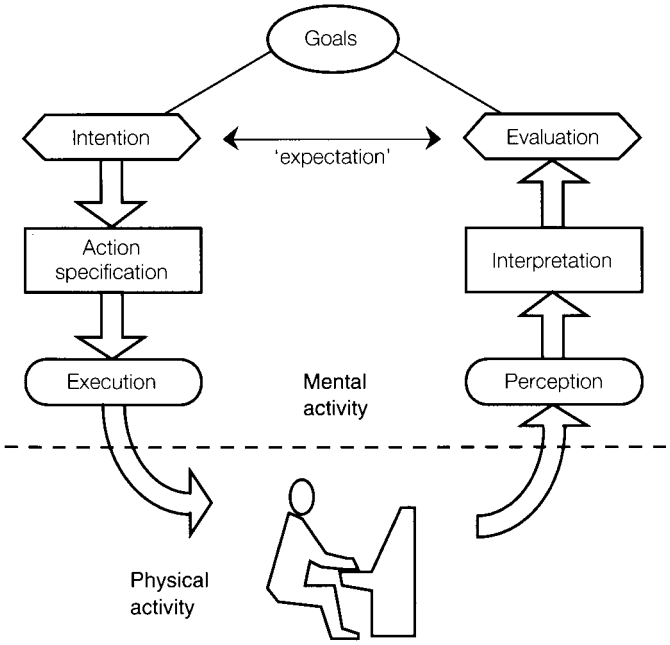
This model is further affected by arousal, motivation, emotional state, etc.





Eye Movement: 230 [70-700] ms

Norman's model of interaction.



- Establish the goal to be achieved.
- Form an intention for action that will achieve the goal.
- Specify the action sequence corresponding to the intention.
- Execute the action.
- Perceive the system state.
- Interpret the state as perceived.
- Evaluate the system state with respect to the goal and intentions.

Knowledge and Mental Models

Knowledge organization: Semantic networks

Knowledge dependencies, relationships, and sequences.

Mental Models (From Preece):

Within cognitive psychology, the term "mental models" has since been explicated by Johnson-Laird (1983, 1988) with respect to its structure and function in human reasoning and language understanding. In terms of the structure of mental models, Johnson-Laird argues that mental models are either analogical representations or a combination of analogical and propositional representations. They are distinct from, but related to, images. A mental model represents the relative position of a set of objects in an analogical manner that parallels the structure of the state of objects in the world. An image also does this, but more specifically in terms of a *view* of a particular model.

A mental model assumes the existence of certain assumptions or expectations based on that model. Whatever the "model" actually is primes the individual to assume certain things about the object in question.
This leads directly to the use of the metaphor.

Metaphors

One of the most powerful techniques used in user-interface design is that of the metaphor. We make use of cultural, contextual, world knowledge to allow user to assume certain things about an application.
Example: MacOS "desktop"

Files, Folders, Trash Can. You can throw away any of these items by putting them in the trash. They stay there until you empty the trash. You can take them back out of the trash if you haven't emptied it yet.

What is the conceptual model of a window with a scrollbar?
A. Text moving under a window
B. A window moving over text